Imaging and Microspectroscopy at the National Synchrotron Light Source

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Introduction

Welcome to the National Synchrotron Light Source (NSLS), one of the world's foremost synchrotron research facilities and a unique laboratory for utilizing synchrotron light for imaging and microspectroscopy research. It is the two fundamental aspects of the synchrotron light produced at the NSLS – its intensity and broad energy range – that make it so well suited for this type of research.

The intensity of the synchrotron light produced at the NSLS is 1,000 – 10,000 times greater than that produced by convention laboratory sources. It also has a very small angular divergence due to the small cross-section of the electron source, so that very small (sub-micron) beams can be produced with very high photon density, or brightness. In imaging terms, the brighter the light, the more detail that can be observed, giving us the capability to produce images of extremely small or dilute samples, determine elemental or molecular concentration gradients, and probe the chemical states of elements and compounds in a variety of materials with very high spatial resolution.

A unique strength of the NSLS imaging and microspectroscopy capabilities is the broad range of wavelengths available from the VUV and x-ray rings. With the combined use of bending magnets and insertion devices, the spectrum of light produced at the NSLS extends from the hard x-rays with wavelengths as small 0.1 Å, to the far-infrared, with wavelengths longer than 10^7 Å (or 1 mm). Compared to the other synchrotron facilities in the United States, the NSLS still provides the broadest available spectrum to users in a single facility. A wide array of analytical techniques are available due to the broad spectral range, including Fourier Transform InfraRed Micro-Spectroscopy (FTIRMS), Scanning Transmission X-ray Microscopy (STXM), hard x-ray microprobe analysis, Computed X-ray Micro-Tomography (CMT), Diffraction Enhanced Imaging (DEI), and microbeam x-ray diffraction.

In this guidebook, the first section focuses on the details of these techniques. Each section is written by the people that know them best, the beamline spokespersons and local contacts. In the second section, we highlight how individual scientists are finding innovative ways to combine the varied types of data these micro-analytical instruments can provide, in order to solve complex scientific problems in a variety of fields such as biological and medical sciences, earth and environmental sciences, extraterrestrial research, materials science, and nanotechnology.